

## PATENT ABSTRACTS OF JAPAN

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(54) **ELECTRONIC SHUTTER DRIVING METHOD FOR SOLID-STATE  
IMAGE PICKUP DEVICE AND SOLID-STATE IMAGE PICKUP DEVICE**

(57)Abstract:

PROBLEM TO BE SOLVED: To provide an electronic shutter driving method for solid-state image pickup device and a solid-state image pickup device with which a sharp still picture can be provided by simultaneously providing the same object optical image irradiation time when electronic shutter operation is performed.

SOLUTION: First of all a reset switch  $S_{ra}$  and a switch  $T_r$  for charge transfer are turned on. After the potential of a cathode  $S_d'$  of a photodiode  $D$  and the potential of a non-grounded side terminal  $S_c'$  of a capacitor  $C$  are respectively set to a reset potential  $V_{st}$  the reset switch  $S_{ra}$  is turned off but the switch  $T_r$  for charge transfer is still turned on and in such a state the object optical image is irradiated by the photodiode  $D$ . The charge of the photodiode  $D$  at that time is transferred and held through the switch  $T_r$  for charge transfer to the capacitor  $C$  for charge storage. In such a state a switch  $SW_v$  for video signal read is turned on.

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### CLAIMS

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[Claim(s)]

[Claim 1] An image sensor from which resistance or an accumulated electric charge changes according to incident light quantity from an object light image characterized by

comprising the followingA switch for reset which applies fixed voltage to said image sensor and in which a fixed electric charge is stored upA switch for charge transfer which transmits an electric charge accumulated in said image sensorand a capacitor for charge storages which accumulates an electric charge from said image sensor transmitted by said switch for charge transferAn electronic shutter drive method of a solid state camera which possesses a switch for video signal outputs which sends out an electric charge accumulated in said capacitor for charge storages as a video signal as each pixel of two or more pixels arranged at two-dimensional matrix form.

The 1st step that makes one simultaneously said switch for reset and said switch for charge transfer of all the pixelsand makes said image sensor of all the pixelsand potential of said capacitor for charge storages the value same just before an image pick-up of an object light image. The 2nd step that makes off simultaneously said switch for reset and said switch for charge transfer of all the pixels following said 1st step.

The 3rd step that transmits an electric charge according to incident light quantity from an object light image which controlled only said switch for charge transfer of all the pixels to one after predetermined timeand was accumulated in said image sensor following said 2nd step to said capacitor for charge storages.

[Claim 2]An image sensor from which resistance or an accumulated electric charge changes according to incident light quantity from an object light imageA switch for reset which applies fixed voltage to said image sensor and in which a fixed electric charge is stored upA switch for charge transfer which transmits an electric charge accumulated in said image sensorand a capacitor for charge storages which accumulates an electric charge from said image sensor transmitted by said switch for charge transferIt is an electronic shutter drive method of a solid state camera which possesses a switch for video signal outputs which sends out an electric charge accumulated in said capacitor for charge storages as a video signal as each pixel of two or more pixels arranged at two-dimensional matrix formThe 1st step that makes one simultaneously said switch for reset and said switch for charge transfer of all the pixelsand makes said image sensor of all the pixelsand potential of said capacitor for charge storages the value same just before an image pick-up of an object light imageBy turning OFF said switch for reset

of all the pixelscontrolling said switch for charge transfer to one as it is following said 1st stepand transmitting an electric charge according to incident light quantity from an object light image accumulated in said image sensor to said capacitor for charge storagesThe 2nd step to which charge quantity of said image sensor and said capacitor for charge storages is changed simultaneouslyAn electronic shutter drive method of a solid state camera by which the 3rd step that turns OFF said switch for charge transfer of all the pixels after predetermined timeand controls said switch for video signal outputs of each pixel to one one by one being included following said 2nd step.

[Claim 3]An image sensor from which resistance or an accumulated electric charge changes according to incident light quantity from an object light image characterized by comprising the followingA switch for reset which applies fixed voltage to said image sensor and in which a fixed electric charge is stored upA switch for charge transfer which transmits an electric charge accumulated in said image sensorand a capacitor for charge storages which accumulates an electric charge from said image sensor transmitted by said switch for charge transferA solid state camera which possesses a switch for video signal outputs which sends out an electric charge accumulated in said capacitor for charge storages as a video signal as each pixel of two or more pixels arranged at two-dimensional matrix form.

After making one simultaneously said switch for reset and said switch for charge transfer of all the pixelsmake off said switch for reset of all the pixelsand.An electronic shutter drive to which charge quantity of said image sensor and said capacitor for charge storages is simultaneously changed by controlling said switch for charge transfer to predetermined time oneand transmitting an electric charge according to incident light quantity from an object light image accumulated in said image sensor to said capacitor for charge storages.

A reading means which controls an electric charge accumulated in said capacitor for charge storages of all the pixels in order of a predetermined pixelcontrols said switch for video signal outputs to one one by oneand is serially read as a video signal.

[Claim 4]The solid state camera according to claim 3 making capacity value of said capacitor for charge storages into a value as for which size becomes rather than stray capacitance of said image sensor.

[Claim 5]An image sensor from which resistance changes according to incident light quantity from an object light imageA constant current source which sends fixed current through said image sensorand a switch for voltage transmission which transmits voltage of said image sensorA capacitor for voltage accumulation transmitted in voltage changed into voltage change by sending fixed current from said constant current source in a change in resistance by incident light quantity from said object light image when said switch for voltage transmission is oneVoltage accumulated in said capacitor for voltage accumulation is a solid state camera which possesses a switch for video signal outputs sent out as a video signal as each pixel of two or more pixels arranged at two-dimensional matrix formPrescribed period one of said switch for voltage transmission of all the pixels is carried out simultaneouslyAn electronic shutter drive made to hold during the OFF of voltage from said image sensor of each pixel transmitted to said capacitor for voltage accumulation of each pixel of said switch for voltage transmissionA solid state camera controlling voltage at the time of accumulation of said capacitor for voltage accumulation of all the pixels in order of a predetermined pixelcontrolling said switch for video signal outputs to one one by oneand having a reading means serially read as a video signal.

[Claim 6]An image sensor from which resistance changes according to incident light quantity from an object light imageA constant current source which sends fixed current through said image sensorand a switch for voltage transmission which transmits voltage of said image sensorA capacitor for voltage accumulation by which voltage changed into voltage change by sending fixed current from said constant current source in a change in resistance by incident light quantity from said object light image is transmitted when said switch for voltage transmission is oneIt is a solid state camera which possesses a switch for video signal outputs which sends out voltage accumulated in said capacitor for voltage accumulation as a video signal as each pixel of two or more pixels arranged at two-dimensional matrix formA shutter pattern generating means which generates arbitrary electronic shutter patternsPrescribed period one of said switch for voltage transmission of a pixel decided by said electronic shutter pattern generated in said shutter pattern generating means is carried out simultaneouslyAfter transmitting voltage from said image sensor to said capacitor for voltage

accumulation voltage at the time of accumulation of an electronic shutter driving means which makes off said switch for voltage transmission of a pixel decided by said electronic shutter pattern and in which transmission voltage is stored up and said capacitor for voltage accumulation of all the pixels. A solid state camera controlling said switch for video signal outputs to one by one in order of a predetermined pixel and having a reading means serially read as a video signal.

[Claim 7] The solid state camera according to claim 5 or 6 forming further an electric power switch which impresses power supply voltage to said constant current source when said switch for voltage transmission is on and intercepts power supply voltage to said constant current source when said switch for voltage transmission is OFF.

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## DETAILED DESCRIPTION

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[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the electronic shutter drive method of a solid state camera and solid state camera with which the electronic shutter drive method of a solid state camera and the solid state camera were started especially the image sensor has been arranged at matrix form.

[0002]

[Description of the Prior Art] Drawing 10 shows the circuit diagram of an example of the important section of the conventional solid state camera. In the figure the switches SWa and SWb by photo-diode PD1 and a MOSFET (field effect transistor) constitute one pixel of a solid state camera. By drawing 10 it is perpendicularly accepted by 2 pixels and the solid state camera is illustrated although two-dimensional arrangement of a majority of this pixel is carried out. In the figure the gate of the switch SWb for video signal outputs of each pixel arranged horizontally is connected common to V1 line. The source of the switch SWb for video signal outputs of each pixel arranged perpendicularly is connected to the output terminal OUT in common via the source and drain of switch SH1 by a MOSFET. [0003] Switch SH2 by a MOSFET is connected to the switch equivalent to SWb of the pixel similarly arranged to perpendicularly it does not illustrate. The horizontal driving pulse H1 is impressed to the gate of switch SH1. The vertical driving pulse V1 is impressed to the gate of the switch SWb.

[0004] Next the outline of operation of the solid state

camera used by a system conventionally [ this ] is explained taking the case of one pixel. First image formation of the object light image is carried out to photo-diode (sensor) PD1. Hereby the S1. pulse impressed to the gate of the switch SWa for reset the switch SWa for reset is made one and the cathode voltage of photo-diode PD1 is beforehand reset to Ecc. The charge quantity in which photo-diode PD1 is accumulated according to the light volume from a photographic subject changes after reset.

[0005] Next are one [ the switch SWb for video signal outputs and SH1 / the vertical driving pulse V1 and the horizontal driving pulse H1 ] respectively and the charge quantity which changed from photo-diode PD1 by this lets the switch SWb for video signal outputs and SH1 pass and is sent to the output terminal OUT as a picture signal. At this time since the electric charge of photo-diode PD1 is consumed it makes the switch SWa for reset one again and is made into the following image pick-up waiting state.

[0006] In the state where the switch SWb of each pixel which same operation is performed and is horizontally arranged about other pixels is considered as one by the same vertical driving pulse V1 when switch SH1 and SH2 grade are considered one by one as one by the horizontal driving pulse H1 and H2 grade the charge quantity of the photo-diode of each pixel arranged horizontally is serially sent to the output terminal OUT one by one as a picture signal. [0007] In

the state where the switch of the switch SWb for video signal outputs of each pixel arranged by the following vertical driving pulse V2 to the horizontal direction for following one line is considered as one if read-out for one line finishes the charge quantity of each photo-diode of the line is serially sent to the output terminal OUT one by one as a picture signal when switch SH1 and SH2 grade are considered one by one as one by the horizontal driving pulse H1 and H2 grade. [0008] However if the picture signal sent to the output terminal OUT is used as standard-method television signal such as NTSC system or a PAL system since it is necessary to scan per line in the above-mentioned conventional solid state camera. After forming the switch SWa for reset corresponding to each photo-diode and making these the one within the retrace line period of a line simultaneously the switch SWb for video signal output etc. are made the one per within the video-signal period of a line one by one. Therefore the irradiation time of the object light image acquired by carrying out the switch SWb for video signal output etc. to one immediately after one [ the switch SWa for reset ] Since the irradiation time of the

object light image acquired in the line period of the last direction by carrying out the switch SWb for video signal output etc. to one differs after one [ the switch SWa for reset ] there is a fault that the size of the video signal to the same object light image is not constant.

[0009] Then the solid state camera which makes storage time for every pixel regularity is conventionally known by performing simultaneously read-out of the line of one and the electronic shutter of other lines during a 1-pixel signal period (JPH11-239299A).

[0010] The proposal which the electronic shutter drive of a solid state camera tends to be made using a conventional CMOS type image sensor is made variously (for example JPH11-177076A). It is the composition of having provided the accumulating part which accumulates an electric charge temporarily between the photoelectric conversion part and the amplifier in this conventional solid state camera having provided the second transfer part between the first transfer part and the accumulating part and the amplifier between the photoelectric conversion part and the accumulating part respectively and having given the electronic shutter function to all the pixel coincidence.

[0011] Namely in this conventional solid state camera as shown in drawing 11 the electric charge accumulated in photoelectric conversion part Pd according to the \*\*\*\* object light figure is transmitted to the accumulating part 1e by making the first transfer part 1a one. Next after turning OFF the first transfer part 1a the electric charge transmitted to the accumulating part 1e is further transmitted to the amplifier JFET by making the second transfer part 1b one. The electric charge transmitted to the amplifier JFET is used as a video signal which carried out the shutter drive to all the pixel coincidence.

[0012]

[Problem to be solved by the invention] By the way the shutter speed of the electronic shutter of a solid state camera is till the moment of carrying out the switch for video signal outputs to one from the moment the switch for reset changed from one at OFF and if this is not simultaneously performed in the image sensor of the whole 1 screen clear Still Picture Sub-Division is not obtained. However in the conventional solid state camera given in JPH11-239299A the electronic shutter of the whole object light image does not become but merely fixes storage time for every pixel only and is a request. Only an indistinct picture is acquired when the whole picture of one sheet is not simultaneously operated by an electronic

shuttertherefore it picturizes an animation.

[0013]On the other handin the conventional solid state camera indicated by JPH11-177076Aaccumulation of the following object light image starts the moment of turning OFF the first transfer part 1a of drawing 11. Thereforea storage period is till the moment of making the first transfer part 1a one next from the moment of turning OFFand before the first transfer part 1a of this period is turned onit needs to reset the electric charge of the accumulating part 1e. For this reasonthe reset part 1c is neededimage sensor constituent face products other than photoelectric conversion part Pd increasethe utilization efficiency over an object light image fallssensitivity fallsand there is a problem of also generating the noise by a reset action further.

[0014]The electric charge of photoelectric conversion part Pd according to an object light image since photoelectric conversion part Pd does not have a reset functionEven when the first transfer part 1a is turned onit is not thoroughly transmitted to the accumulating part 1ebut a part remains in photoelectric conversion part Pdand since it is mixed at the time of accumulation of the following incident lightthis electric charge that remained is difficult to obtain the good momentary images as an electronic shutter picture. Thereforewhen considering it as an outputted imageby irradiating with photoelectric conversion part Pd of the whole 1 screen by the object light image of the same time by an electronic shutter in the conventional solid state camera. The reset part 1c is requiredutilization efficiency is bada reset noise is also generatedand it becomes image quality degradationand remaining charge is also contained in photoelectric conversion part Pdand there is a problem that good Still Picture Sub-Division is not obtained.[0015]When it is made in view of the above point and electronic shutter operation is performedan object of this invention is to provide the electronic shutter drive method of a solid state camera and solid state camera which can obtain a clear still picture by acquiring the same object light image irradiation time simultaneously.

[0016]Other purposes of this invention have a reset part in providing the electronic shutter drive method of a solid state camera and solid state camera which can obtain good Still Picture Sub-Division in which remaining charge with unnecessary and sufficient utilization efficiency is not contained.

[0017]

[Means for solving problem]This invention in order to



attain the above-mentioned purpose an electronic shutter drive method of this inventionAn image sensor from which resistance or an accumulated electric charge changes according to incident light quantity from an object light imageA switch for reset which applies fixed voltage to an image sensor and in which a fixed electric charge is stored upA switch for charge transfer which transmits an electric charge accumulated in an image sensorand a capacitor for charge storages which accumulates an electric charge from an image sensor transmitted by the switch for charge transferAn electronic shutter drive method of a solid state camera which possesses a switch for video signal outputs which sends out an electric charge accumulated in a capacitor for charge storages as a video signal as each pixel of two or more pixels arranged at two-dimensional matrix form is characterized by comprising:

The 1st step that makes one simultaneously a switch for reset and a switch for charge transfer of all the pixelsand makes an image sensor of all the pixelsand potential of a capacitor for charge storages the value same just before an image pick-up of an object light image.

The 2nd step that makes off simultaneously a switch for reset and a switch for charge transfer of all the pixels following the 1st step.

The 3rd step that transmits an electric charge according to incident light quantity from an object light image which controlled only a switch for charge transfer of all the pixels to one after predetermined timeand was accumulated in an image sensor following the 2nd step to a capacitor for charge storages.

[0018]In this inventionan electric charge according to light volume of an object light image which entered into all the image sensors can be simultaneously accumulated in a capacitor for charge storages of all the pixels with a point temporarily [ the ]respectively.[0019]This invention this invention electronic shutter drive methodAn image sensor from which resistance or an accumulated electric charge changes according to incident light quantity from an object light image in order to attain the above-mentioned purposeA switch for reset which applies fixed voltage to an image sensor and in which a fixed electric charge is stored upA switch for charge transfer which transmits an electric charge accumulated in an image sensorand a capacitor for charge storages which accumulates an electric charge from an image sensor transmitted by the switch for charge transferAn electronic shutter drive method of a solid state

camera which possesses a switch for video signal outputs which sends out an electric charge accumulated in a capacitor for charge storages as a video signal as each pixel of two or more pixels arranged at two-dimensional matrix form is characterized by comprising:

The 1st step that makes one simultaneously a switch for reset and a switch for charge transfer of all the pixels and makes an image sensor of all the pixels and potential of a capacitor for charge storages the value same just before an image pick-up of an object light image.

Following the 1st step turn OFF a switch for reset of all the pixels and a switch for charge transfer is controlled to one as it is. The 2nd step to which charge quantity of an image sensor and a capacitor for charge storages is simultaneously changed by transmitting an electric charge according to incident light quantity from an object light image accumulated in an image sensor to a capacitor for charge storages.

The 3rd step that turns OFF a switch for charge transfer of all the pixels after predetermined time and controls a switch for video signal outputs of each pixel to one one by one following the 2nd step.

[0020] The charge quantity of an image sensor and the capacitor for charge storages having made it make it change simultaneously by transmitting the electric charge according to the incident light quantity from the object light image accumulated in the image sensor of all the pixels to the capacitor for charge storages in this invention. A sake When the potential of an image sensor and the capacitor for charge storages is in the same state suppose that the switch for charge transfer is off.

[0021] In order to attain the above-mentioned purpose this invention solid state camera The image sensor from which resistance or the accumulated electric charge changes according to the incident light quantity from an object light image The switch for reset which applies fixed voltage to an image sensor and in which a fixed electric charge is stored up The switch for charge transfer which transmits the electric charge accumulated in the image sensor and the capacitor for charge storages which accumulates the electric charge from the image sensor transmitted by the switch for charge transfer It is a solid state camera which possesses the switch for video signal outputs which sends out the electric charge accumulated in the capacitor for charge storages as a video signal as each pixel of two or more pixels arranged at two-dimensional matrix form After making

one simultaneously the switch for reset and the switch for charge transfer of all the pixels make off the switch for reset of all the pixels and. By controlling the switch for charge transfer to predetermined time one and transmitting the electric charge according to the incident light quantity from the object light image accumulated in the image sensor to the capacitor for charge storage Control the electric charge accumulated in the electronic shutter drive to which the charge quantity of an image sensor and the capacitor for charge storage is changed simultaneously and the capacitor for charge storage of all the pixels in order of a predetermined pixel and the switch for video signal outputs is controlled to one by one It has composition which has a reading means serially read as a video signal. [0022] The charge quantity of an image sensor and the capacitor for charge storage having made it make it change simultaneously by transmitting the electric charge according to the incident light quantity from the object light image accumulated in the image sensor of all the pixels to the capacitor for charge storage in this invention A sake When the potential of an image sensor and the capacitor for charge storage is in the same state suppose that the switch for charge transfer is off.

[0023] Hereas for the capacity value of the above-mentioned capacitor for charge storage it is more desirable than the stray capacitance of an image sensor to make it the value as for which size becomes. When the switch for charge transfer is come by off it is because almost all electric charges are accumulated in the capacitor for charge storage. [0024] In order to attain the above-mentioned purpose the solid state camera of this invention The image sensor from which resistance changes according to the incident light quantity from an object light image The constant current source which sends fixed current through an image sensor and the switch for voltage transmission which transmits the voltage of an image sensor The capacitor for voltage accumulation transmitted in the voltage changed into voltage change by sending fixed current from a constant current source in the change in resistance by the incident light quantity from an object light image when the switch for voltage transmission is one The voltage accumulated in the capacitor for voltage accumulation is a solid state camera which possesses the switch for video signal outputs sent out as a video signal as each pixel of two or more pixels arranged at two-dimensional matrix form An electronic shutter drive which is made to carry out prescribed period one of the switch for voltage

transmission of all the pixels simultaneously and is made to hold during the OFF of the voltage from the image sensor of each pixel transmitted to the capacitor for voltage accumulation of each pixel of the switch for voltage transmission. The voltage at the time of accumulation of the capacitor for voltage accumulation of all the pixels is controlled in order of a predetermined pixel. The switch for video signal outputs is controlled to one by one and it has composition which has a reading means serially read as a video signal.

[0025] In this invention even if it does not use a resetting means it irradiates with the image sensor of all the pixels of the whole 1 screen by the object light image of the same time by an electronic shutter and an output video signal can be acquired.

[0026] The image sensor from which resistance changes according to the incident light quantity from an object light image in order that the solid state camera of this invention may attain the above-mentioned purpose. The constant current source which sends fixed current through an image sensor and the switch for voltage transmission which transmits the voltage of an image sensor. The capacitor for voltage accumulation by which the voltage changed into voltage change by sending fixed current from a constant current source in the change in resistance by the incident light quantity from an object light image is transmitted when the switch for voltage transmission is one. The switch for video signal outputs which sends out the voltage accumulated in the capacitor for voltage accumulation as a video signal. The shutter pattern generating means which is a solid state camera provided as each pixel of two or more pixels arranged at two-dimensional matrix form and generates arbitrary electronic shutter patterns. Prescribed period one of the switch for voltage transmission of the pixel decided by the electronic shutter pattern generated in the shutter pattern generating means is carried out simultaneously. After transmitting the voltage from an image sensor to the capacitor for voltage accumulation, the voltage at the time of accumulation of the electronic shutter driving means which makes off the switch for voltage transmission of the pixel decided by the electronic shutter pattern and in which transmission voltage is stored up and the capacitor for voltage accumulation of all the pixels. The switch for video signal outputs is controlled to one by one in order of a predetermined pixel and it has composition which has a reading means serially read as a video signal.

[0027] In this invention after holding the voltage of the image

sensor of the pixel decided by arbitrary electronic shutter patterns to the capacitor for voltage accumulation it can read as a video signal. [0028] The solid state camera of this invention impressed power supply voltage to the constant current source when the switch for voltage transmission was on and when the switch for voltage transmission was OFF it formed further the electric power switch which intercepts the power supply voltage to a constant current source in order to attain the above-mentioned purpose. In this invention when the switch for voltage transmission is OFF with an electric power switch in order to make a constant current source non-operative when the switch for voltage transmission is OFF the current which flows into an image sensor can be stopped.

[0029]

[Mode for carrying out the invention] Next an embodiment of the invention is described with Drawings. Drawing 1 shows the electronic shutter drive method of a solid state camera and the circuit system figure of a 1st embodiment of the important section of a solid state camera which become this invention. Drawing 1 is illustrating a total of four pixels which adjoin two perpendicular directions two horizontally among the pixels of a large number arranged by two-dimensional matrix form respectively. Photo-diode D1-1 as image sensor with which each pixel performs photoelectric conversion and D1-2 and D2-1 and D2-2. It consists of switch SW1-1 for reset and SW1-2 and SW2-1 SW2-2 switch Tr1-1 for charge transfer and Tr1-2 and Tr2-1 and Tr2-2 capacitor C1-1 for charge storage and C1-2 and C2-1 and C2-2.

[0030] Each non-grounded side terminal of capacitor C1-1 for charge storage and C2-1 Common connection is carried out to level signal switch SH1 via the drain of switch SV1-1 for video signal outputs and SV2-1 the source and the line L1 Common connection of each non-grounded side terminal of capacitor C1-2 for charge storage and C2-2 is carried out to level signal switch SH2 via the drain of switch SV1-2 for video signal outputs and SV2-2 the source and the line L2. Level signal switch SH1 SH2 and other level signal switches that are not illustrated are considered as the level read pulse H1 which is outputted from the level actuator 11 and inputted into a gate H2 and the period one with other high-level level read pulses which are not illustrated and are considered as period OFF of a low level.

[0031] Switch SV1-k for video signal outputs arranged to switch SV1-1 for video signal outputs and SV1-2 and horizontally [ other ] it does not illustrate is simultaneously considered as one or OFF by the vertical read pulse V1 of a horizontal scanning cycle which is

outputted from the vertical-drive part 12 and inputted into a gate. Similarly switch SV2-k for video signal outputs arranged to switch SV2-1 for video signal outputs SV2-2 and horizontally [ other ] it does not illustrate is simultaneously considered as one or OFF by the vertical read pulse V2 of a horizontal scanning cycle which is outputted from the vertical-drive part 12 and inputted into a gate. The vertical read pulses V1 and V2 differ in a period only 1 horizontal scanning cycle. [0032] Switch Tr1-1 for charge transfer and Tr1-2 and Tr2-1 and Tr2-2 Transfer pulse tp1-1 outputted to each of those gates from electronic shutter drive 13 and tp1-2 and tp2-1 and tp2-2 are impressed and switching control is carried out so that this may become one simultaneously. Reset pulse vp1-1 outputted to each of those gates from vertical-drive part 12 and vp1-2 and vp2-1 and vp2-2 are impressed and switch SWa1-1 for reset and SWa1-2 and SWa2-1 and SWa2-2 are reset simultaneously.

[0033] One pixel with the above-mentioned arbitrary solid state camera can be rewritten as shown in drawing 2 (A). Identical codes are given to drawing 1 and an identical configuration portion among the figure and a subscript in a mark is omitted. A source of the switch SWa for reset according [ on drawing 2 (A) and / a cathode ] to a field effect transistor (FET) in the photo-diode D while being connected to a reset voltage source via a drain it is connected to a drain or a source of switch SV for video signal outputs by the capacitors C and FET for charge storages via a drain of the switch Tr for charge transfer by FET and a source. [0034] Next a timing chart of drawing 3 (A) is combined referred to and explained about operation of this embodiment. First the transfer pulse tp of short high level shown in drawing 3 (A) is impressed to a gate of the switch Tr for charge transfer at the same time the reset pulse vp of short high level shown in drawing 3 (A) is impressed to a gate of the switch SWa for reset. Thereby one [ the switch SWa for reset and the switch Tr for charge transfer / respectively ] simultaneously. [0035] By one [ the switch SWa for reset ] a drain of the switch SWa for reset Via a source potential of the cathode Sd of the photo-diode D is fixed to the reset potential Vsas shown in drawing 3 (A) The switch Tr for charge transfer is also one at this time and since switch SV is OFF potential of non-grounded side terminal Sc of the capacitor C is fixed to the reset potential Vs as shown in drawing 3 (A).

[0036] Next as shown in drawing 3 (A) both the reset pulse vp and the transfer pulse tp are set to a low level the switch SWa

for reset and the switch Tr for charge transfer are turned off respectively and an object light image is irradiated by the photo-diode D. An electric charge occurs from the photo-diode D with the dose of this object light image and it discharges and as the potential of the cathode Sd of the photo-diode D shows drawing 3 (A) it falls gradually from Vs. In the conducting period of this photo-diode D since the transfer pulse tp from an electronic shutter drive (13 of drawing 1) is a low level the switch Tr for charge transfer is OFF and since switch SV for video-signal read-out is also set to OFF by the vertical driving pulse the potential of non-grounded side terminal Sc of the capacitor C is fixed to the reset potential Vs as shown in drawing 3 (A).

[0037] Next after resetting as the above-mentioned transfer pulse tp shows drawing 3 (A) after a prescribed period only a certain period T is made high-level the switch Tr for charge transfer serves as one in this period T and via the drain of the switch Tr for charge transfer and a source the electric charge of the photo-diode D is transmitted to the capacitor C and is held. Thereby as shown in drawing 3 (A) the potential of the cathode Sd of the photo-diode D rises even from Vi to V1 and the potential of non-grounded side terminal Sc of the capacitor C falls even to V2 from Vs. Henceforth the transfer pulse tp serves as a low level it becomes off switching it for charge transfer T and the potential V2 is held at the capacitor C. [0038] It will be in the state where the potential V2 was held to the capacitor C for charge storages of all the pixels by performing from the reset to the above-mentioned photo-diode D and the capacitor C to charge transfer operation to the capacitor C in common to all the pixels of a solid state camera. And one [ this state / switch SV for video-signal read-out ] one by one.

[0039] Thus even the moment that the switch Tr for charge transfer is turned on from the moment that the switch SWa is come by off in this embodiment turns into an electronic shutter period since an electronic shutter period does not change even if one [ the same period is simultaneously obtained to all the pixels and / after this / all the switches for video signal outputs ] one by one good Still Picture Sub-Division without blur of a picture is obtained. [0040] in addition -- this embodiment -- the stray capacitance cd of the photo-diode D -- the capacitor C for charge transfer -- abbreviated -- the same thing is desirable. This is because potential will not change easily if all electric charges cannot be transmitted if there is little capacity of the capacitor C for charge transfer in the case of charge transfer and there is much capacity of the capacitor C for

charge transfer conversely.

[0041] Drawing 2 (B) shows a circuit diagram of a 2nd embodiment of an important section of a solid state camera which becomes this invention. Identical codes are given to drawing 2 (A) and an identical configuration portion among the figure and the explanation is omitted. This 2nd embodiment is the composition which added amplifier SWv2 by FET to switch SWv1 for video signal outputs by FET. about this 2nd embodiment to explain operation with a timing chart of drawing 3 (B) First impress reset pulse vp' shown in drawing 3 (B) of short high level to a gate of the reset switch SWa and and. [ this ] A high-level transfer pulse shown in drawing 3 (B) by tp' is impressed to a gate of the switch Tr for charge transfer from an electronic shutter drive (13 of drawing 1) and this is made one. By this potential of cathode Sd' of the photo-diode D is fixed to the reset potential Vs as shown in drawing 3 (B) The switch Tr for charge transfer is also one at this time and since switch SWv1 is OFF as potential of non-grounded side terminal Sc' of the capacitor C is also shown in drawing 3 (B) it is fixed to the reset potential Vs.

[0042] Then although reset pulse vp' is set to a low level and turns OFF the reset switch SWa Since unlike the above-mentioned embodiment transfer pulse tp' is made succeedingly high-level as shown in drawing 3 (B) the switch Tr for charge transfer is carried out to one as it is and an object light image is irradiated with it by the photo-diode D in this state. this -- object light -- an image -- a dose -- a photo-diode -- D -- from -- an electric charge -- generating -- discharging -- a photo-diode -- D -- a cathode -- Sd -- ' -- potential -- drawing 3 -- (-- B --) -- being shown -- as -- Vs -- from -- a transfer pulse -- tp -- ' -- a low level -- becoming -- a time -- Vi -- ' -- up to -- gradually -- falling .

[0043] During this conducting period since the switch Tr for charge transfer is one The electric charge of the photo-diode D is transmitted to the capacitor C for charge storages through the drain of the switch Tr for charge transfer and a source and as shown in drawing 3 (B) the potential of non-grounded side terminal Sc' of the capacitor C falls even to V2' from Vs. Henceforth transfer pulse tp' is set to a low level it becomes off switching it for charge transfer Tr and potential V2' is held at the capacitor C. [0044] It will be in the state where potential V2' was held to the capacitor C for charge storages of all the pixels by performing from the reset to the above-mentioned photo-diode D and the capacitor C to charge



transfer operation to the capacitor C in common to all the pixels of a solid state camera. And one [ this state / switch SWv1 for video-signal read-out ] one by one. since according to this embodiment it is come by off when the switch Tr for charge transfer is in the state where the potential of Sd' and Sc' is the same -- Sc' -- the noise by switching hardly occurs in a sidebut can obtain a good video signal to it. Even if it reads a video signalthe potential of the capacitor C for charge storages cannot changebut can be read repeatedly.[0045]In the embodiment of drawing 2 (B)more capacity of the capacitor C for charge storages is wanted for there to be than the stray capacitance Cd of the photo-diode D.This is because almost all electric charges are accumulated in the capacitor C for charge storageswhen the switch Tr for charge transfer is come by off.

[0046]Nexta 3rd embodiment of this invention is described.Drawing 4 shows a circuit diagram of a 3rd embodiment of an important section of a solid state camera which becomes this invention. Identical codes are given to drawing 2 (A) and an identical configuration portion among the figureand the explanation is omitted. An embodiment shown in drawing 4 has the feature in a point of having connected the switch SWb for reset by FET to a non-grounded side terminal of the capacitor C for charge storages.[0047]In the case of an example of drawing 3 (A) of operationwith this switch SWb for resetit can be set as positions with an arbitrary pulse at the time of reset of the transfer pulse tp. For exampleby carrying out the switch SWb for reset to one just before the charge transfer period Tand resetting the capacitor C for charge storagesSince the potential V2 of non-grounded side terminal Sc of the capacitor C is maintained with a state for read-outthe video signal can also read an irradiation period of an object light imageand it can extend a setting range of an electronic shutter more just before charge transfer. It is effective when forming a video signal which continued especially. It cannot be overemphasized by changing the switch SWb for reset into a state of OFF that operation of drawing 3 (A) and same operation can be performed.

[0048]Nexta 4th embodiment of this invention is described.Drawing 5 shows a circuit diagram of a 4th embodiment of an important section of a solid state camera which becomes this invention. Drawing 5 constitutes stroke matter of a solid state cameraand to a cathode of the photo-diode D. While a source of the transistor Q1 for constant current sources to which a gate and a drain were

connected is connected it is connected to a source of capacitor  $C_v$  for voltage accumulation and the transistor Q2 via the switch Trv for charge transfer. A gate and a drain are connected to a drain of the switch Q3 for video signal outputs and the transistor Q2 constitutes a buffer amplifier. [0049] Next a timing chart of drawing 6 is combined referred to and explained about operation of this embodiment. If the direct-current driver voltage  $V_{cc}$  is impressed to a gate and a drain of the transistor Q1 the constant current  $I_s$  will flow into the photo-diode D. The resistance  $R_x$  changes according to light volume of an entering object light image and the photo-diode D generates voltage  $V_{d1}$  ( $=I_s \times R_x$ ) in a cathode. This voltage  $V_{d1}$  changes continuously according to an object light image as shown in drawing 6 (A).

[0050] Next to a gate of the voltage transfer switch Trv as shown in drawing 6 (B) If the high-level transfer pulse  $t_p$  is impressed the voltage transfer switch Trv is turned on and at the time of transmission of voltage  $V_{d1}$  through a drain of the voltage transfer switch Trv and a source the voltage  $V_1$  will be transmitted to capacitor  $C_v$  for voltage accumulation and will be held. The voltage  $V_x$  accumulated in capacitor  $C_v$  for voltage accumulation before transmission can be easily changed to the voltage  $V_1$  at the time of transmission by making capacity of capacitor  $C_v$  as small as possible and there being few electric charges accumulated and making it end. [0051] If the resistance  $R_x$  shall fall according to below abbreviated  $10k\Omega$  carrying out the resistance  $R_x$  in case there is no optical exposure of the photo-diode D and incident light quantity increasing and capacity of capacitor  $C_v$  for voltage accumulation shall be  $10\text{ pF}$  or less. Since a damping time constant is expressed with  $R_x \cdot C_v$  it becomes very short with a  $10^{-7}$  ( $=10 \times 10^3 \times 10 \times 10^{-12}$ ) second and voltage transmission is also performed in an instant in proportion to this time. And since the switch Trv for voltage transmission is off an input-impedance value of capacitor  $C_v$  for voltage accumulation other than the time of transmission is very as high as more than abbreviated  $10^{10}\Omega$ . Therefore a damping time constant at this time serves as one ( $=10 \times 10^{10} \times 10 \times 10^{-12}$ ) second and its accumulation performance is also practical for a long time enough to 33 milliseconds of Vertical Synchronizing signal periods of an NTSC television system.

[0052] The transfer pulse  $t_p$  next by making the switch Trv for voltage transmission off as a low level as shown in drawing 6 (B) The voltage  $V_1$  transmitted to capacitor  $C_v$  for voltage accumulation to timing shown by a in front of OFF is

accumulated in capacitor  $C_v$  for voltage accumulation as voltage  $V_{d2}$  [ equivalent to  $V_1$  ] as a' shows to the figure (C). Then by the one by making high-level to timing shown in drawing 6 (D) the pulse  $t_v$  impressed to a gate of the output switch Q3 for video signals. The video signal  $V_{out}$  as the accumulation voltage  $c$  at the one time shows to drawing 6 (E) by  $c'$  via the buffer amplifier Q2 and the switch Q3 for video signal outputs is obtained.

[0053] By making the transfer pulse  $t_p$  into a high-level back low level after 1 vertical scanning period. The voltage  $V_2$  of the photo-diode D transmitted to the timing  $b$  in front of OFF of the transfer switch  $Tr_v$  shown in drawing 6 (A). It is accumulated in capacitor  $C_v$  by timing  $b'$  shown in the figure (C) and terminal voltage (accumulation voltage)  $V_{d2}$  ( $=V_2$ ) of the capacitor  $C_v$  to the timing  $d$  whose switch Q3 for video signal outputs serves as one by the pulse  $t_v$ . It is obtained via the buffer amplifier Q2 and the switch Q3 for video signal outputs as the video signal  $V_{out}$  as shown in drawing 6 (E) by  $d'$ .

[0054] Hereafter if it repeats similarly the stationary video signal which does not have blur for every screen can be obtained. the inside of drawing 6 (E)  $c'$  and  $d'$  -- the output voltage  $V_{out}$  at the time of except is the output voltage from other pixels of composition similarly other than the pixel shown in drawing 5. The output voltage  $V_{out}$  is outputted for example to lines such as the line L1 of drawing 1 and L2. [0055] Next a 5th embodiment of this invention is described. Drawing 7 shows the circuit diagram of a 5th embodiment of the important section of the solid state camera which becomes this invention. Among the figure drawing 5 and an identical configuration portion attach identical codes and omit the explanation. Drawing 7 constitutes the stroke matter of a solid state camera and the feature is at the point of having connected the gate and drain of the transistor Q1 for constant current sources to direct current voltage supply via electric power switch  $SW_{vcc}$ . This electric power switch  $SW_{vcc}$  is one piece common to all the pixels. It is because the switch  $Tr_v$  for voltage transmission of all the pixels is controlled simultaneously at one or OFF.

[0056] Namely the direct current voltage  $V_{cc}$  applied to the transistor Q1 for constant current sources in this embodiment. It aims at omitting at the time of OFF since it is required only when the transfer pulse  $t_p$  is on stopping the current which flows into the photo-diode D and planning power saving. The transfer pulse  $t_p$  is high-level and only when the switch  $Tr_v$  for voltage transmission is considered

as one electric power switch SW<sub>vcc</sub> is made to be considered as one by the transfer pulse  $t_p$ . [0057] Although the transistor Q<sub>1</sub> for constant current sources increased [ 4th and 5th above-mentioned embodiments ] since a transfer part and a reset part are omitted and the transistors Q<sub>2</sub> and Q<sub>3</sub> in drawing 5 and drawing 7 can be formed by one Since it is conventionally [ which was shown in drawing 11 ] equivalent to JFET of equipment the constituent child can compare with equipment conventionally which was shown in drawing 11 and can decrease in number by one. Since a reset pulse is unnecessary the composition of an electronic shutter becomes very easy since one kind of  $t_p$  may be sufficient also as a transfer pulse and the noise by a reset pulse moreover is not generated either the good Still Picture Sub-Division video signal is obtained.

[0058] Next a 6th embodiment of this invention is described. Drawing 8 (A) shows a block diagram of a 6th embodiment of an important section of a solid state camera which becomes this invention. This embodiment is 1 embodiment of the electronic shutter drive 13 of a solid state camera shown in drawing 1 The synchronizing signal generator 21 which generates horizontal driving signal HD the vertical driving signal VD and reference clock Clock based on an outside common synchronized signal and an external Vertical Synchronizing signal respectively The interface circuitry 22 which outputs the area data (Area data) based on CDC The shutter pattern generator 23 which receives each output signal of the above-mentioned synchronizing signal generator 21 and the interface circuitry 22 as an input and generates a clock level area signal vertical area signal and memory pulse a gate pulse etc. It comprises the shift registers 24 and 25 the memories 26 and 27 the gates 28 and 29 and the electronic shutter switch 30. [0059] Operation of this embodiment is explained. First as area data of an electronic shutter by interface circuitry 22 course CDC is inputted into the shutter pattern generator 23 and is memorized from a personal computer etc. Next a horizontal driving signal (HD) a vertical driving signal (VD) and a reference clock signal (Clock) which were generated from the synchronizing signal generator 21 are sent to the shutter pattern generator 23. A horizontal driving signal (HD) from this synchronizing signal generator 21 a vertical driving signal (VD) and a reference clock signal (Clock) are synchronized with external Horizontal Synchronizing signal H.sync and external Vertical Synchronizing signal V.sync if needed.

[0060] Next supply serially the level area data generated

from the shutter pattern generator 23 to the shift register 24 and it is shifted to it one by one with a clock and vertical area data is serially supplied to the shift register 25 and is shifted to it one by one with a clock. Level area data or vertical area data is binary data as shown in drawing 8 (B) by a. Then the shutter pattern generator 23 makes the memory pulse shown in drawing 8 (B) by c high level (one). Namely [ at once ] the level area data and vertical area data which are shown in drawing 8 (B) stored temporarily at the shift registers 24 and 25 respectively by b are parallel transmitted to the memories 26 and 27 and are made to memorize.

[0061] Each horizontal and vertical area data shown in drawing 8 (B) memorized by the memories 26 and 27 respectively by d. Since it is always sent to the gates 28 and 29 provided by corresponding then the shutter pattern generator 23. By making high-level a gate pulse outputted to the gates 28 and 29 at drawing 8 (B) as e shows and making the gates 28 and 29 one. Each horizontal and vertical area data (f2 of drawing 8 (B)) which is memorized by the memories 26 and 27 and which was created with the shutter pattern generator 23 is supplied to the electronic shutter switch 30 at once through the gates 28 and 29. An electronic shutter pattern which consists of each area data level and vertical to the electronic shutter switch 30 by this is memorized.

[0062] Based on the electronic shutter pattern memorized by the electronic shutter switch 30 at this time the transfer pulse tp is outputted to said switch Tr for charge transfer or the switch Trv for voltage transmission from the electronic shutter switch 30. The picture element position where both area data inputted from the area data into which the electronic shutter switch 30 is inputted from the gate 28 and the gate 29 is high-level. The high-level transfer pulse tp is impressed to the gate of the switch Tr for charge transfer or the switch Trv for voltage transmission and it is considered as one.

[0063] Next turn OFF a gate pulse and a different electronic shutter pattern is sent to the electronic shutter switch 30 in the same course. By carrying out the video output switch of all the pixels to one finally at the predetermined order of a pixel collecting as a video signal and reading the multiple image by the electronic shutter of time to differ is obtained as same Still Picture Sub-Division video signal. If it does in this way high-speed video can be easily constituted as a still picture in the same screen.

[0064] Drawing 9 shows the general example of use of a solid

state camera. As shown in the figure the solid state camera 33 condenses the incident light from the object light image 31 by the optical system 32 and photoelectric conversion is entered and carried out to the photo-diode of the solid state camera 33. A video signal is read synchronizing with the synchronized signal from the synchronized signal drive system 34. The signal-processing system 35 is supplied and predetermined signal processing is performed. For example, it is changed into the video signal of NTSC system or a PAL system. [0065] This invention is not limited to the above-mentioned embodiment and can also use transfer pulse tp' shown in drawing 3 (B) for example as the transfer pulse tp of a 1st embodiment shown in drawing 2 (A).

[0066]

[Effect of the Invention] As explained above according to this invention at a point the electric charge according to the light volume of the object light image which entered into all the image sensors temporarily [ the ] by accumulating in the capacitor for charge storages of all the pixels simultaneously respectively. Since the stored charge of the \*\*\*\* object light figure of the same time can be read a clear still picture can be obtained easily.

[0067] According to this invention since the switch for charge transfer can turn OFF when the potential of an image sensor and the capacitor for charge storages is in the same state by changing simultaneously the charge quantity of the image sensor of all the pixels and the capacitor for charge storages a picture with few reset noises can be acquired.

[0068] According to this invention irradiating with the image sensor of all the pixels of the whole 1 screen by the object light image of the same time by an electronic shutter and having acquired the output video signal even if it did not use a resetting means A sake since the composition of an electronic shutter can be simplified dramatically and the noise by a reset pulse is not generated either the Still Picture Sub-Division video signal of good quality can be obtained.

[0069] After holding the voltage of the image sensor of the pixel decided by arbitrary electronic shutter patterns to the capacitor for voltage accumulation according to this invention having made it read as a video signal A sake By highlighting the picture of the field of the request in one screen or changing a shutter position video can be divided into two or more still pictures and can also be displayed.

[0070] According to this invention since the current which flows into an image sensor was stopped when the switch for voltage transmission was OFF by making a constant current

source non-operative with an electric power switch when the switch for voltage transmission is OFF power consumption can be reduced.

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## DESCRIPTION OF DRAWINGS

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[Brief Description of the Drawings]

[Drawing 1] It is the electronic shutter drive method of a solid state camera and the circuit system figure of a 1st embodiment of the important section of a solid state camera which become this invention.

[Drawing 2] It is a circuit diagram of 1st and 2nd embodiments of the important section of the solid state camera which becomes this invention.

[Drawing 3] It is a timing chart for explanation of operation of drawing 2.

[Drawing 4] It is a circuit diagram of a 3rd embodiment of the important section of the solid state camera which becomes this invention.

[Drawing 5] It is a circuit diagram of a 4th embodiment of the important section of the solid state camera which becomes this invention.

[Drawing 6] It is a timing chart for explanation of operation of drawing 5.

[Drawing 7] It is a circuit diagram of a 5th embodiment of the important section of the solid state camera which becomes this invention.

[Drawing 8] It is the 6th block diagram and signal waveform diagram of an embodiment of an important section of a solid state camera that become this invention.

[Drawing 9] It is a figure showing an example of the example of use of a solid state camera.

[Drawing 10] It is a circuit diagram of an example of equipment conventionally.

[Drawing 11] It is a circuit diagram of other examples of equipment conventionally.

[Explanations of letters or numerals]

- 11 Level actuator
- 12 Vertical-drive part
- 13 Electronic shutter drive
- 21 Synchronizing signal generator
- 22 Interface circuitry
- 23 Shutter pattern generator
- 24 and 25 Shift register
- 26 and 27 Memory
- 28 and 29 Gate

30 Electronic shutter switch  
SWa and SWa1-1 and SWa1-2 and SWa2-1SWa2-2and SWb Switch  
for reset  
SV and SV1-1 and SV1-2 and SV2-1SV2-2SWv1and Q3 Switch for  
video signal outputs  
D Photo-diode  
Tr Switch for charge transfer  
C The capacitor for charge storages  
Cd Photo-diode stray capacitance  
vp and vp' reset pulse  
tp and tp1-1 and tp1-2 and tp2-1 and tp2-2 Pulse for  
electric charge (voltage) transmission  
Q1 Transistor for constant current sources  
Q2 buffer amplifier  
Trv Switch for voltage transmission  
Cv Capacitor for voltage accumulation  
Vd1 Photo-diode terminal voltage  
Vd2 Voltage accumulation capacitor terminal voltage

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